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(54) **VEHICLE NAVIGATION PLAYBACK METHOD**

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(51) **Int. Cl.**

G01C 21/00	(2006.01)
G08G 1/123	(2006.01)
G01C 21/36	(2006.01)
G10L 13/00	(2006.01)
G08G 1/0968	(2006.01)

(52) **U.S. Cl.**

CPC ***G01C 21/3629*** (2013.01); ***G10L 13/00*** (2013.01); *G01C 21/365* (2013.01); *G01C 21/3632* (2013.01); *G08G 1/096855* (2013.01); *G08G 1/096872* (2013.01)

(58) **Field of Classification Search**

CPC G01C 1/3629; G01C 21/3632; G01C 21/365; G08G 1/096855; G08G 1/096861; G08G 1/096866; G08G 1/096872

USPC 701/23–25, 35–36, 200–202, 204, 701/206–209, 211–213, 300, 431, 432, 433, 701/436, 437, 440, 441, 443; 340/988–990, 340/995.1, 995.12, 995.14, 995.17–995.2, 340/995.23, 995.27, 995.24; 704/258–260; 379/908

See application file for complete search history.

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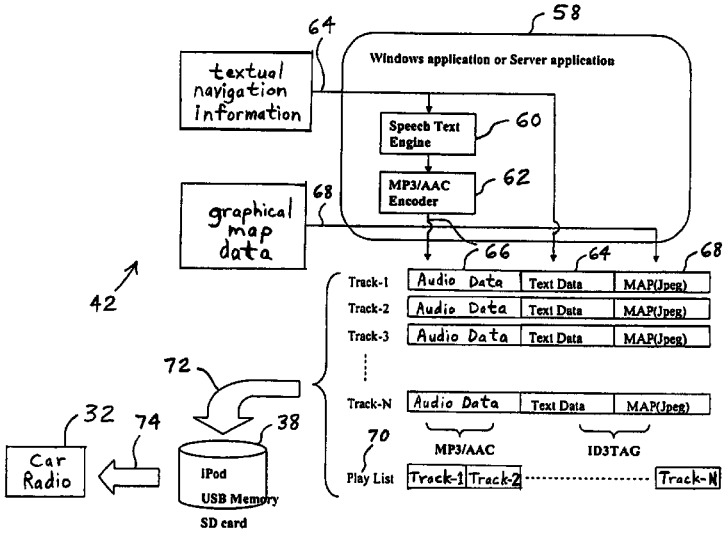
(74) *Attorney, Agent, or Firm* — Laurence S. Roach, Esq.

(57) **ABSTRACT**

An automotive vehicle navigation method includes obtaining electronic textual navigation information and converting the textual navigation information into audio data. The audio data is stored within the vehicle and is played back within the vehicle in sequential increments that correspond to respective legs of a trip being made by the vehicle.

2 Claims, 11 Drawing Sheets



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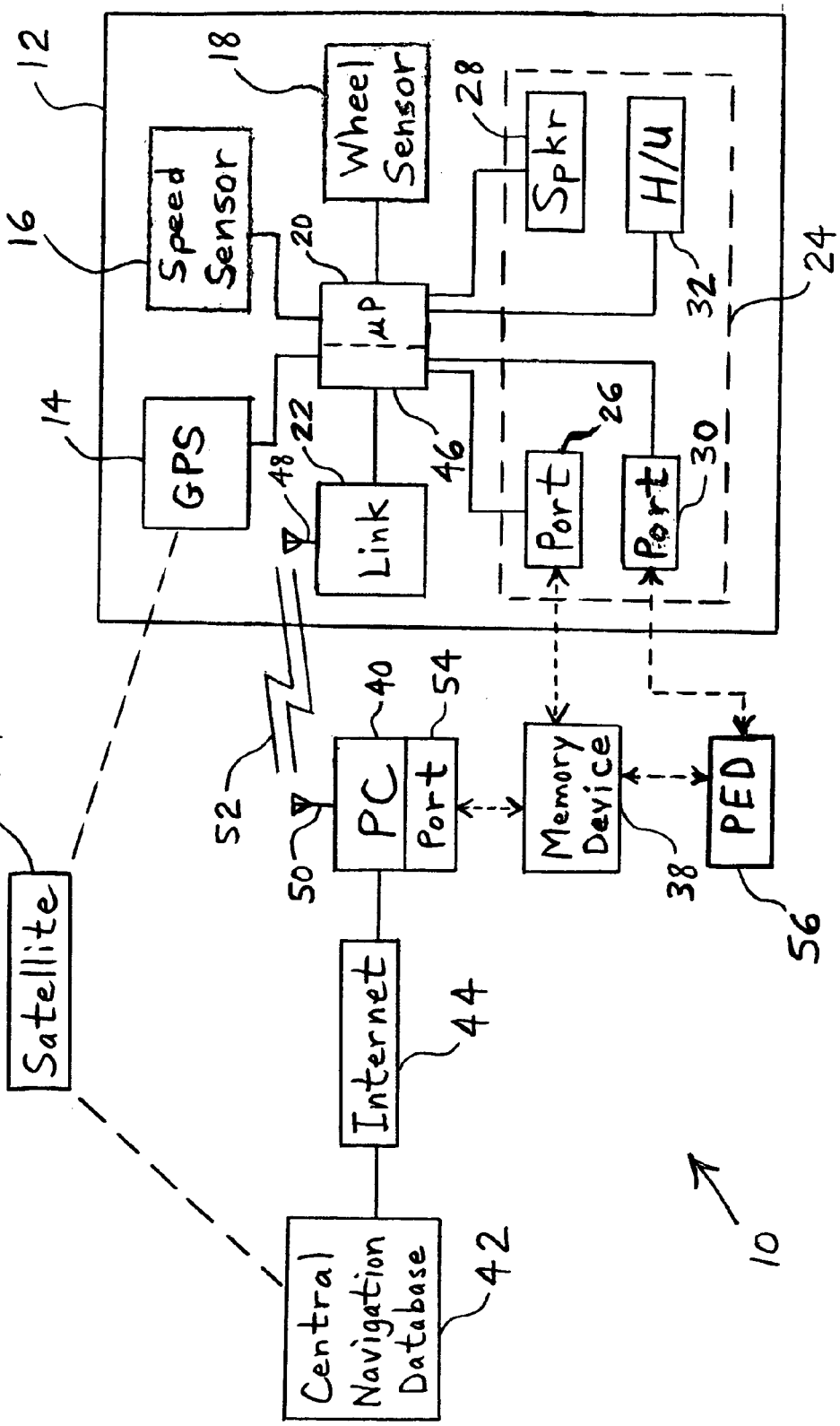

12
18
Wheel Sensor
28
Spkr
H/U
16
Speed Sensor
20
μP
32
24
14
GPS
22
48
Link
46
26
Port
30
Port
34
52
40
54
PC
Port
Memory Device
PED
Satellite
50
38
56
Internet
44
Central Navigation Database
42
10

FIG. 1

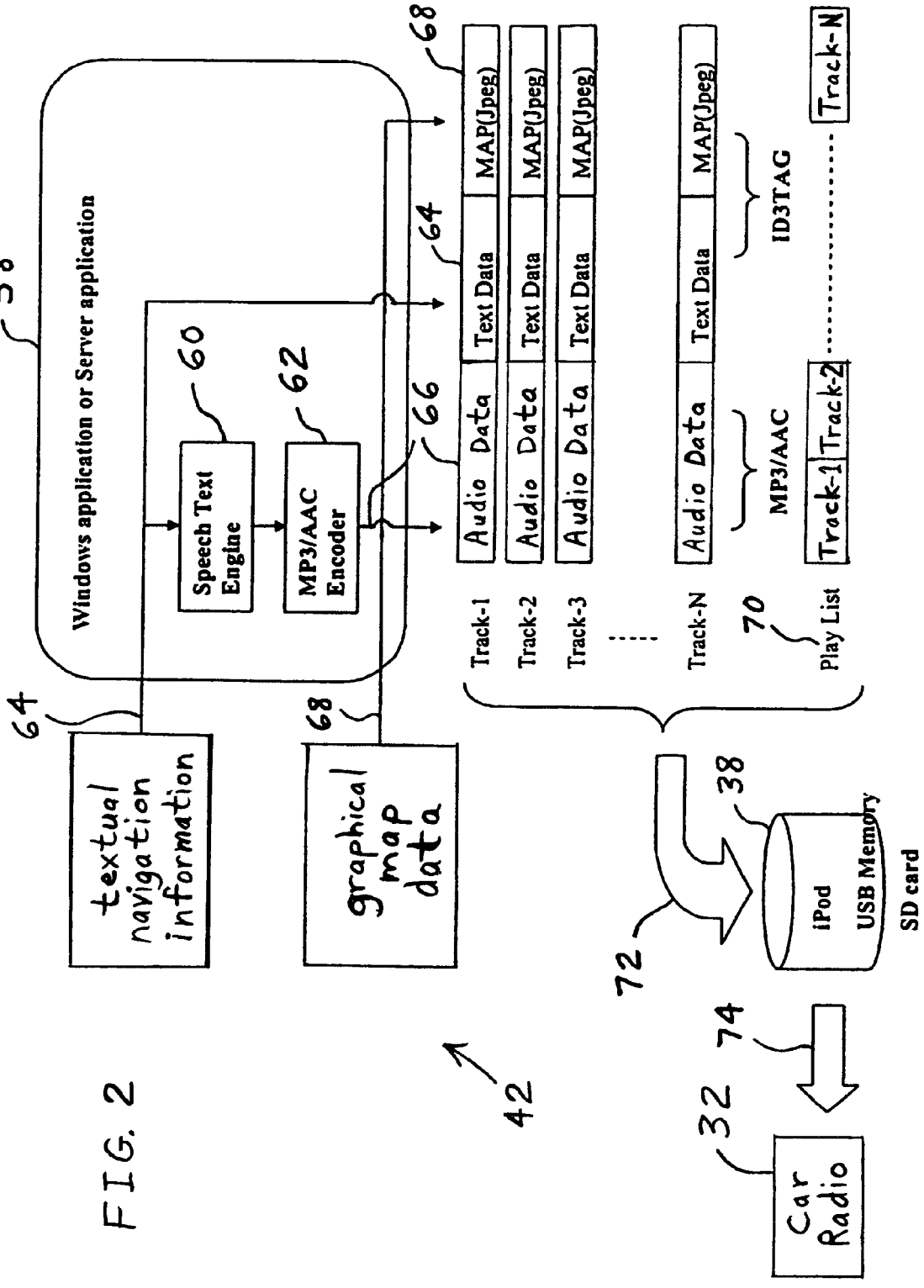

58
Windows application or Server application
Speech Text Engine
60
MP3/AAC Encoder
62
64
66
68
textual navigation information
graphical map data
Audio Data
Text Data
MAP(Jpeg)
Track-1
Track-2
Track-3
Track-N
Play List
70
MP3/AAC
ID3TAG
Track-1
Track-2
Track-N
72
38
iPod
USB Memory
SD card
42
74
32
Car Radio

FIG. 2

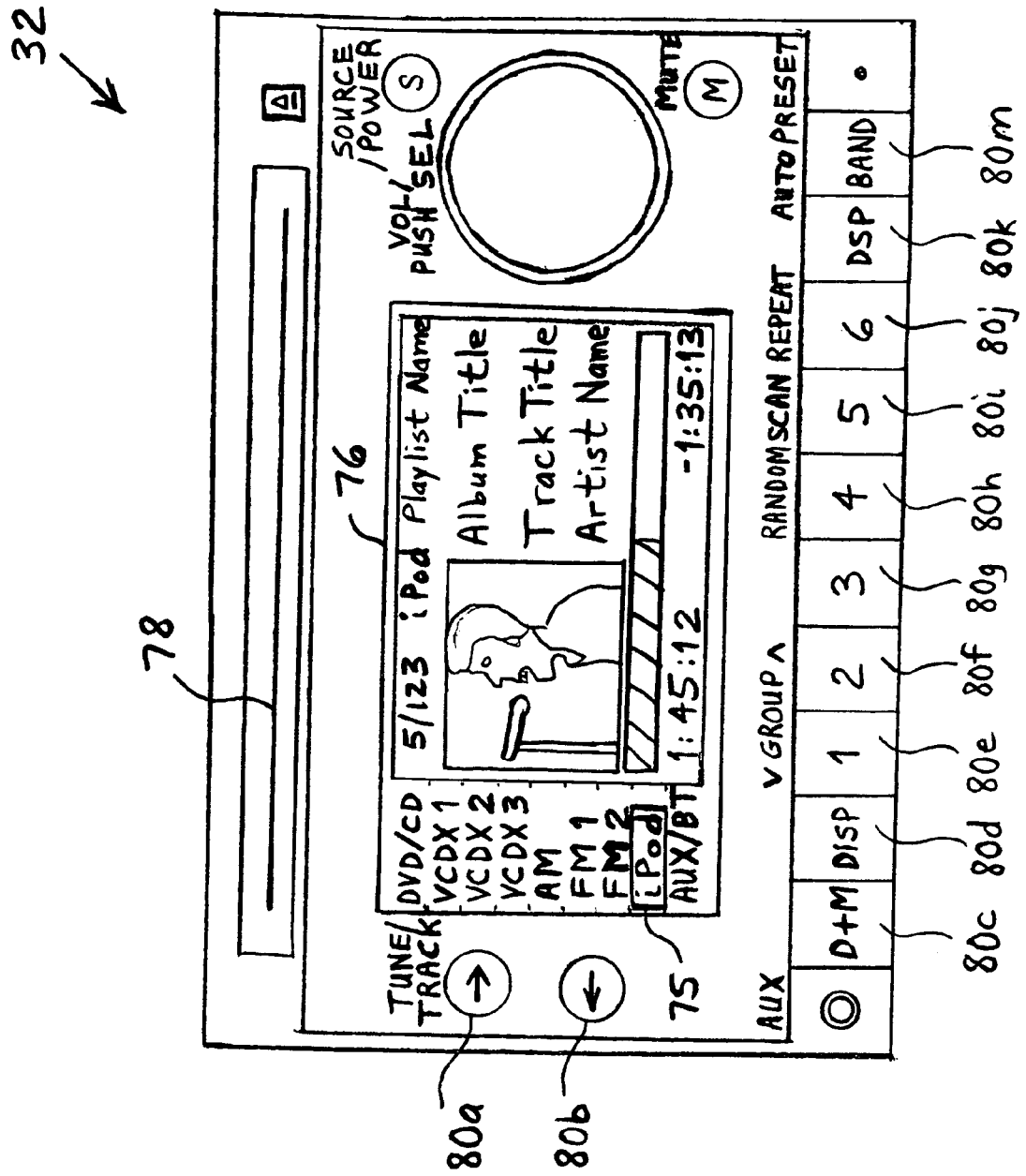

32
78
SOURCE /POWER
VOL PUSH SEL
MUTE
76
5/123 iPod Playlist Name
Album Title
Track Title
Artist Name
1:45:12
-1:35:13
DVD/CD
VCDX 1
VCDX 2
VCDX 3
AM
FM 1
FM 2
iPod
AUX/BT
TUNE/ TRACK
75
80a
80b
AUX
GROUP
RANDOM
SCAN
REPEAT
AUTO PRESET
D+M
DISP
1
2
3
4
5
6
DSP
BAND
80c
80d
80e
80f
80g
80h
80i
80j
80k
80m

FIG. 3

FIG. 4

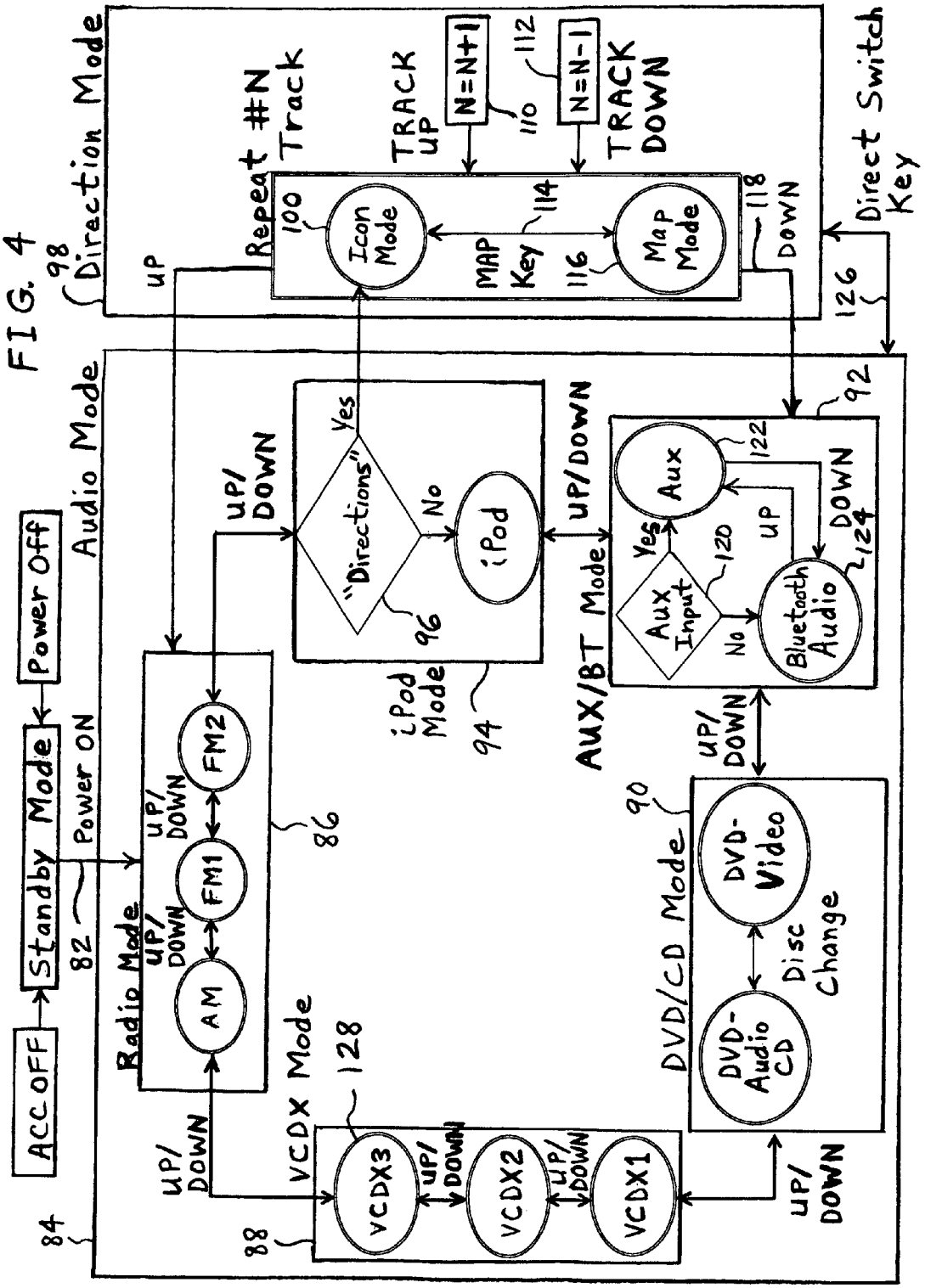
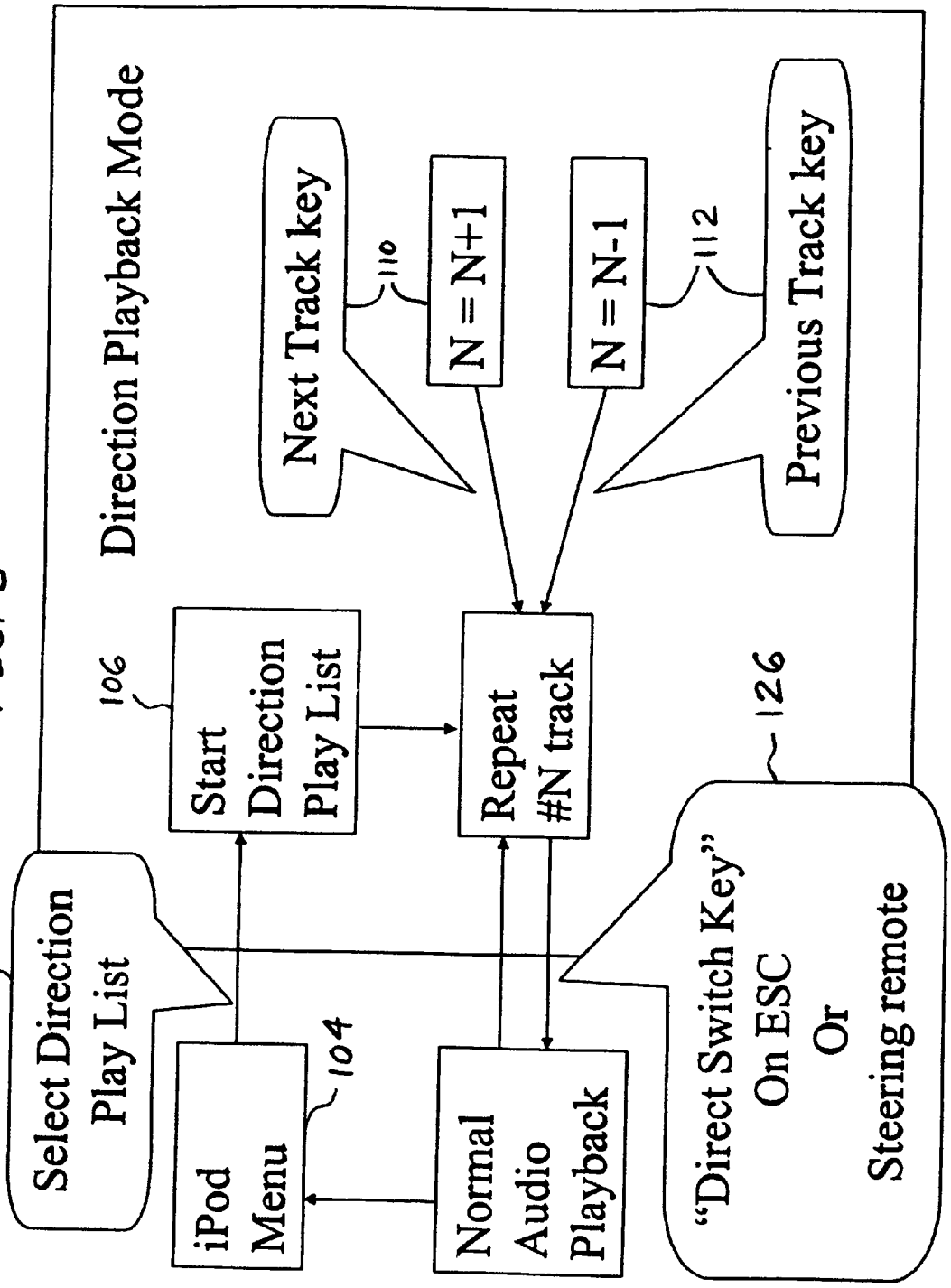

Direction Mode
98
Repeat #N Track
TRACK UP
N=N+1
110
112
N=N-1
TRACK DOWN
100
Icon Mode
MAP Key
114
116
Map Mode
118
DOWN
UP
Direct Switch Key
126
Audio Mode
Power Off
Standby Mode
Power ON
82
ACC OFF
84
UP/DOWN
"Directions"
Yes
No
96
iPod
iPod Mode
94
UP/DOWN
Aux
122
Yes
Aux Input
120
No
UP
DOWN
124
Bluetooth Audio
AUX/BT Mode
92
Radio Mode
AM
FM1
FM2
86
VCDX Mode
128
VCDX3
VCDX2
VCDX1
88
DVD/CD Mode
90
DVD-Video
DVD-Audio CD
Disc Change

FIG. 5


Direction Playback Mode
Select Direction Play List
102
Start Direction Play List
106
Repeat #N track
iPod Menu
104
Normal Audio Playback
Next Track key
110
N = N+1
N = N-1
112
Previous Track key
"Direct Switch Key" On ESC Or Steering remote
126

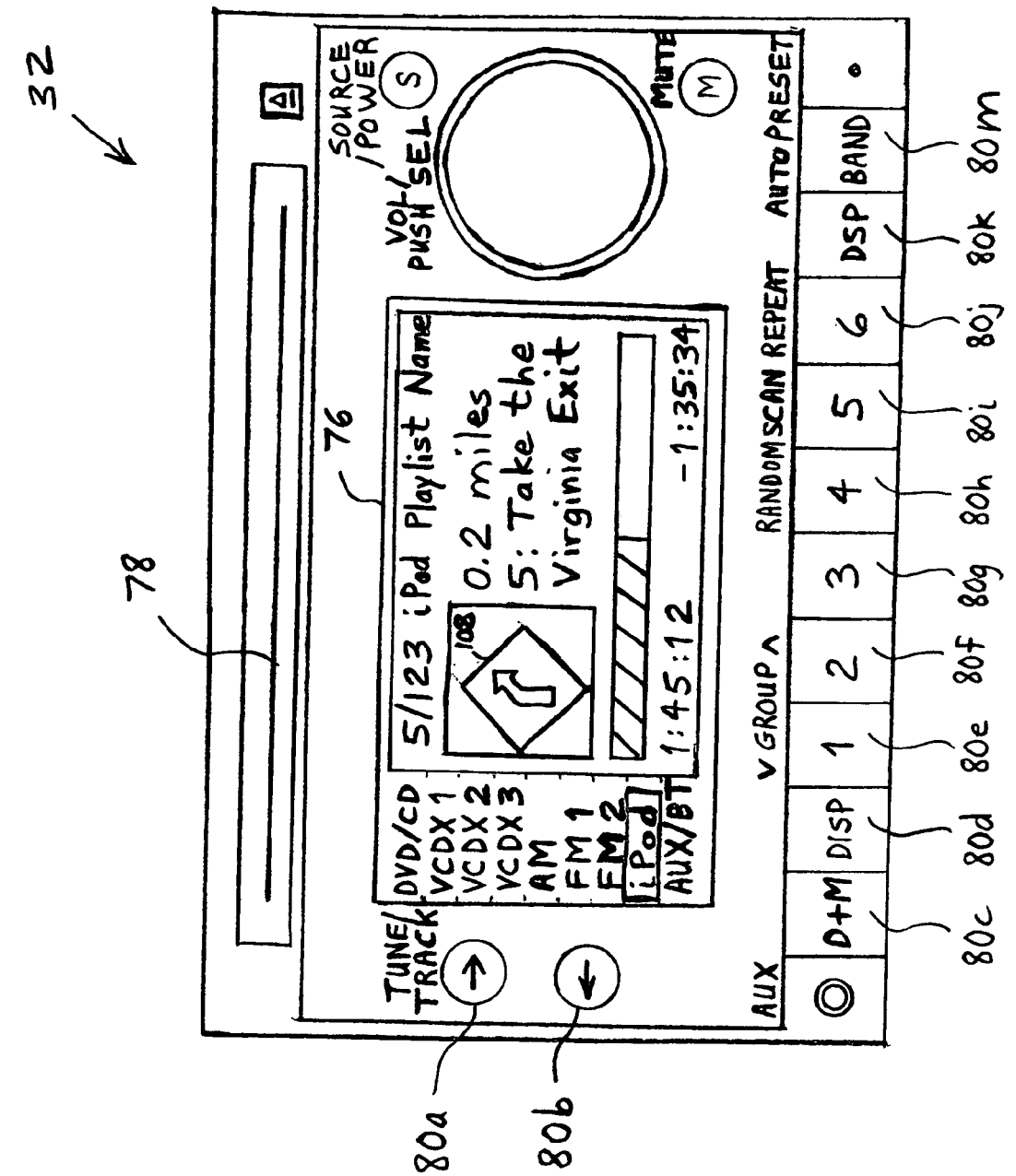

32
78
76
SOURCE /POWER
VOL/ PUSH SEL
MUTE
5/123 iPod Playlist Name
0.2 miles
5: Take the Virginia Exit
108
1:45:12
-1:35:34
DVD/CD
VCDX 1
VCDX 2
VCDX 3
AM
FM 1
FM 2
iPod
AUX/BT
TUNE/ TRACK
80a
80b
AUX
D+M
DISP
GROUP
1
2
3
4
5
6
RANDOM
SCAN
REPEAT
DSP
AUTO PRESET
BAND
80c
80d
80e
80f
80g
80h
80i
80j
80k
80m

FIG. 6

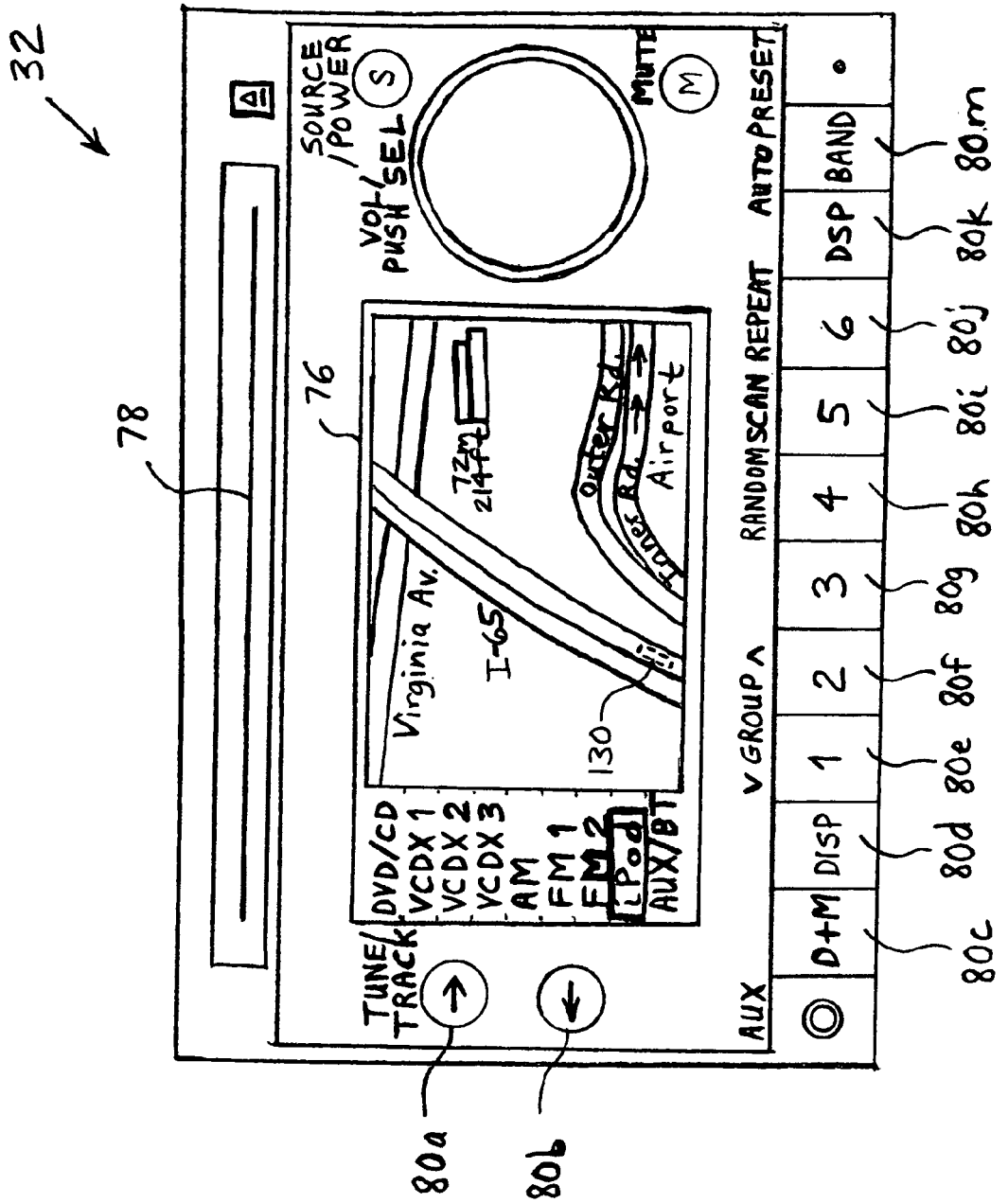

32
78
76
SOURCE /POWER
VOL-/ PUSH SEL
MUTE
DVD/CD
VCDX 1
VCDX 2
VCDX 3
AM
FM 1
FM 2
iPod
AUX/BT
TUNE/ TRACK
Virginia Av.
I-65
Outer Rd.
Airport
130
AUX
GROUP
RANDOM
SCAN
REPEAT
AUTO PRESET
D+M
DISP
1
2
3
4
5
6
DSP
BAND
80a
80b
80c
80d
80e
80f
80g
80h
80i
80j
80k
80m

FIG. 7

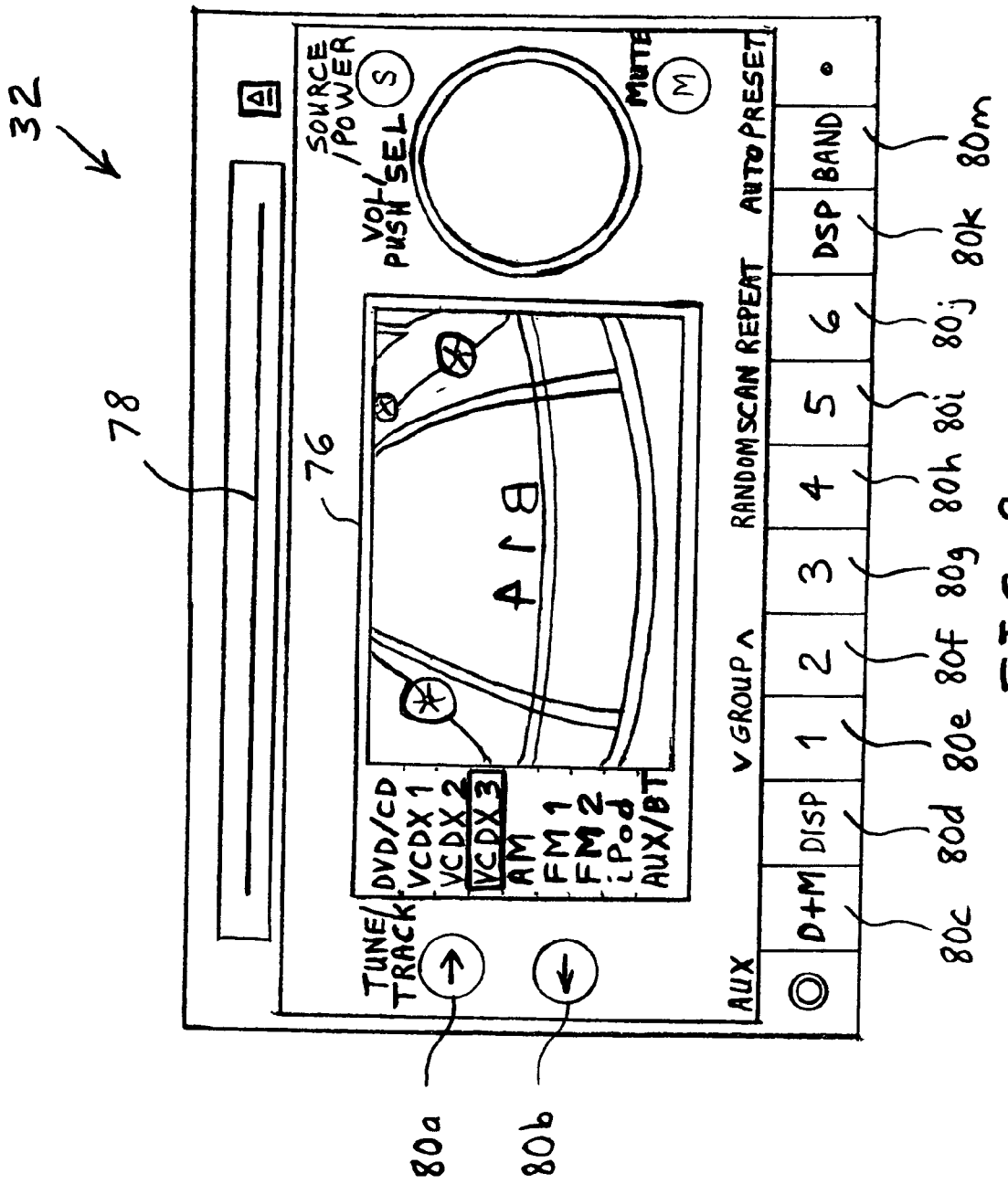

32
78
76
SOURCE /POWER
VOL PUSH SEL
MUTE
TUNE/ TRACK
DVD/CD
VCDX 1
VCDX 2
VCDX 3
AM
FM 1
FM 2
iPod
AUX/BT
AUX
GROUP
RANDOM
SCAN
REPEAT
AUTO PRESET
D+M
DISP
1
2
3
4
5
6
DSP
BAND
80a
80b
80c
80d
80e
80f
80g
80h
80i
80j
80k
80m

FIG. 8

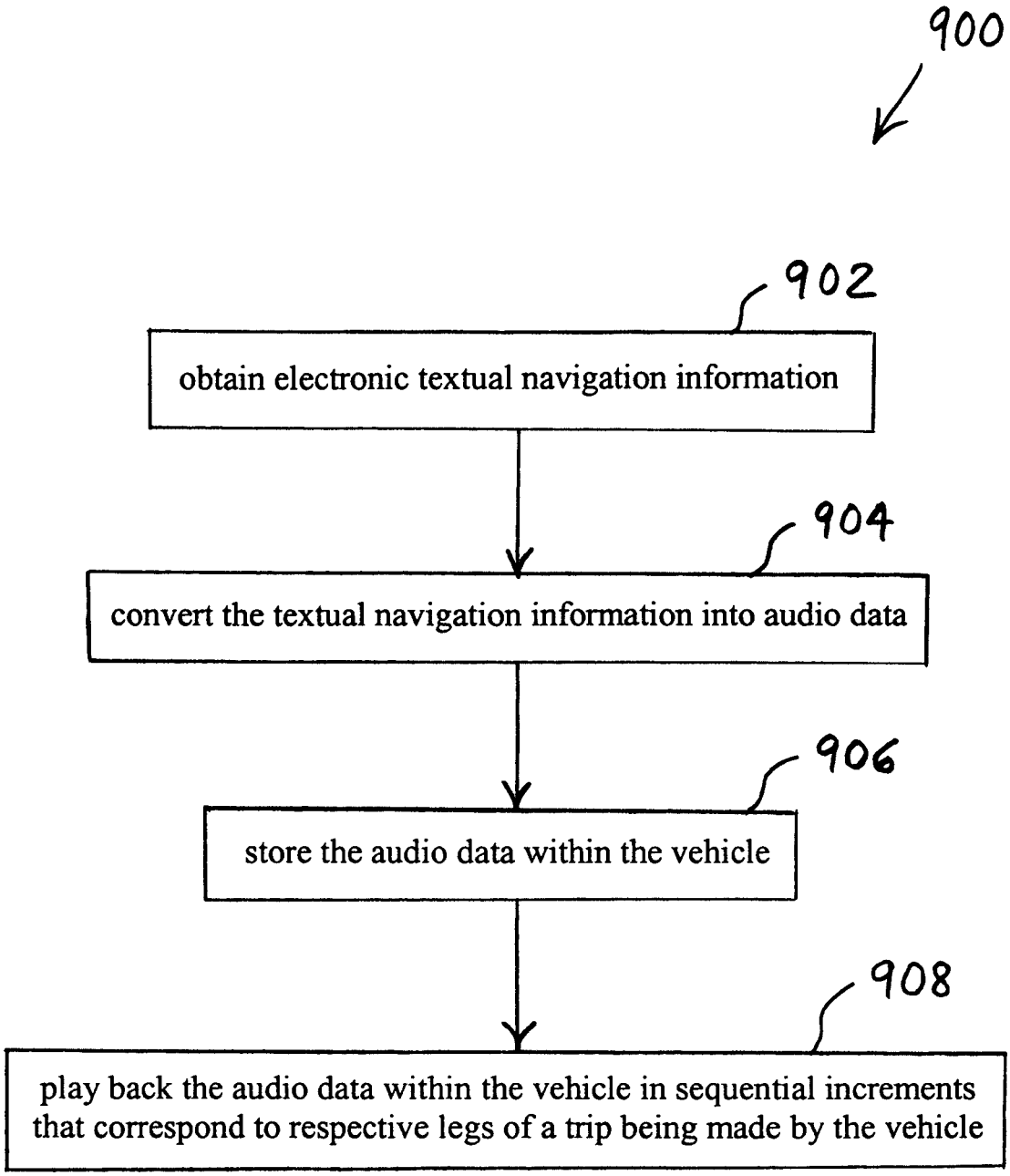

900
902
obtain electronic textual navigation information
904
convert the textual navigation information into audio data
906
store the audio data within the vehicle
908
play back the audio data within the vehicle in sequential increments that correspond to respective legs of a trip being made by the vehicle

FIG. 9

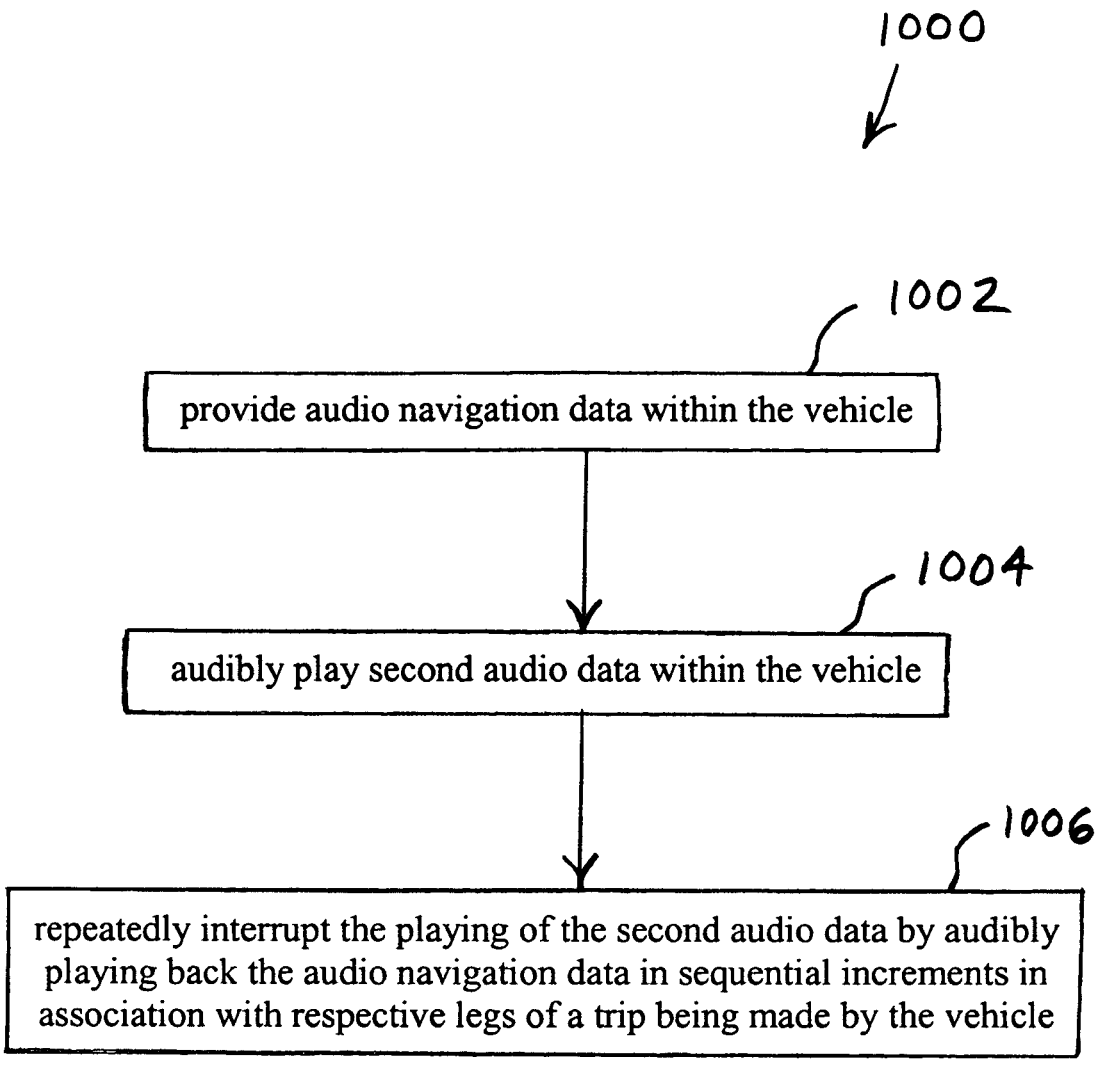

1000
1002
provide audio navigation data within the vehicle
1004
audibly play second audio data within the vehicle
1006
repeatedly interrupt the playing of the second audio data by audibly playing back the audio navigation data in sequential increments in association with respective legs of a trip being made by the vehicle

FIG. 10

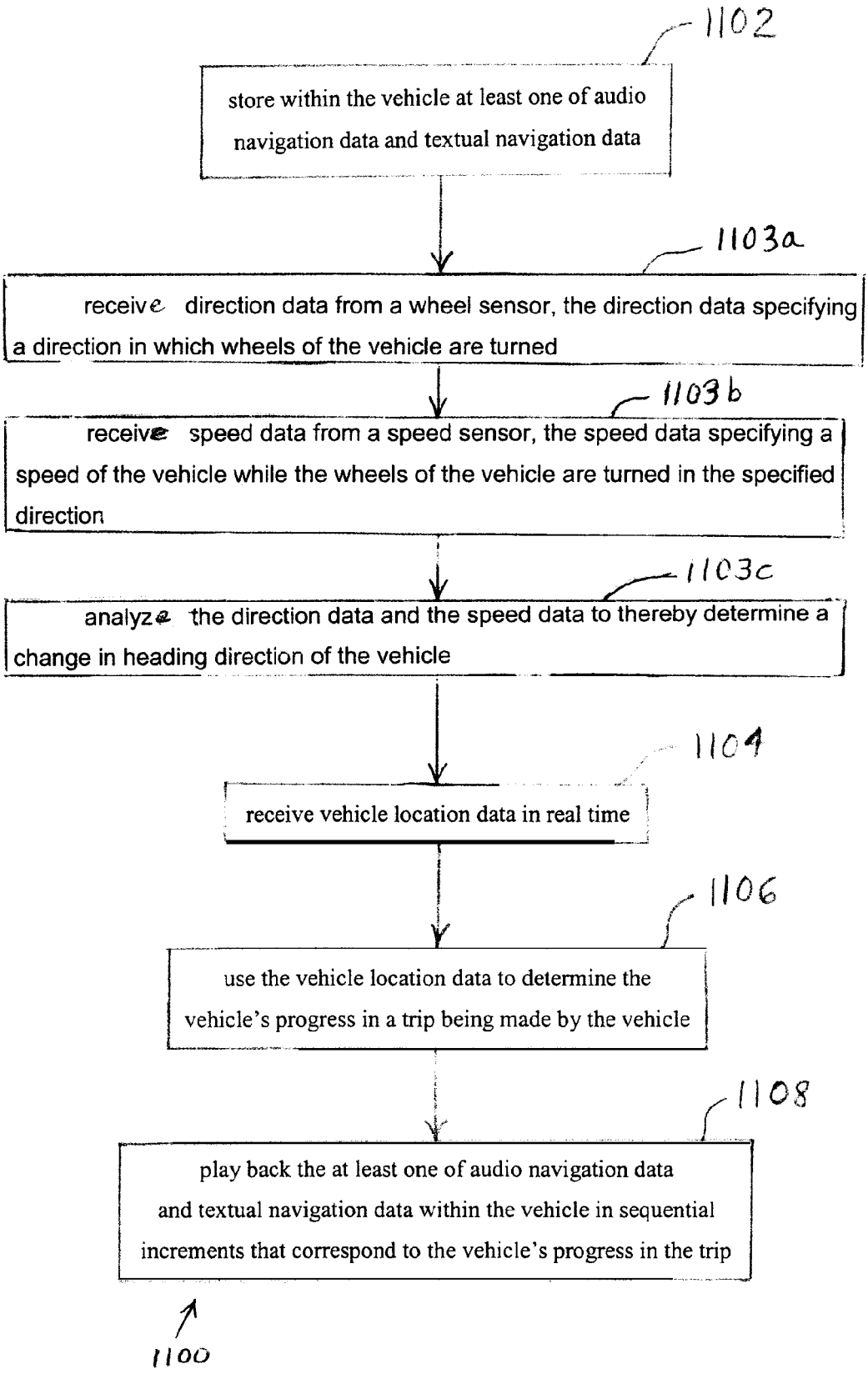

1102
store within the vehicle at least one of audio navigation data and textual navigation data
1103a
receive direction data from a wheel sensor, the direction data specifying a direction in which wheels of the vehicle are turned
1103b
receive speed data from a speed sensor, the speed data specifying a speed of the vehicle while the wheels of the vehicle are turned in the specified direction
1103c
analyze the direction data and the speed data to thereby determine a change in heading direction of the vehicle
1104
receive vehicle location data in real time
1106
use the vehicle location data to determine the vehicle's progress in a trip being made by the vehicle
1108
play back the at least one of audio navigation data and textual navigation data within the vehicle in sequential increments that correspond to the vehicle's progress in the trip
1100

FIG. 11

VEHICLE NAVIGATION PLAYBACK METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Patent Application Ser. No. 60/919,357, filed 22 Mar. 2007 and entitled VEHICLE NAVIGATION PLAYBACK METHOD.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to electronic vehicle navigation systems.

2. Description of the Related Art

Navigation systems are provided in vehicles, such as automobiles, for providing assistance to occupants of the vehicles in finding their way to their destinations. The navigation system typically includes a global positioning system (GPS) that tracks the changing locations of the vehicle on the surface of the earth in real time. The navigation system also stores extensive map data that enables the navigation system to track the changing street locations of the vehicle based upon the GPS data. A video screen may display the mapping of streets in the vicinity of the vehicle, as well as the current location of the vehicle on the grid of interconnected roadways.

One difficulty associated with the above-described navigation systems is that they typically do not provide text instructions regarding what streets to turn on and the distances involved. Rather, only a map with the current location of the vehicle thereon is provided. However, because of the spatial skills required, many users find maps inherently difficult to read, especially while driving. Hence, such users may find text directions to be easier to understand and more useful.

Another difficulty is that the world-wide map information utilized by conventional navigation systems requires a large amount of memory capacity to store, as well as considerable processing capability to display. These memory and processing requirements, and their associated costs, result in the system designer having to make compromises in the detail and user-friendliness of the display of the navigation maps.

Yet another difficulty is that conventional navigation systems typically provide navigation information in only video form, and do not provide navigation information in audio form. Thus, it may be difficult for a driver to interpret the visual information on the video screen while still watching the road while he is driving.

What is needed in the art is a vehicle navigation system that is capable of supplying navigation directions in text and/or audio form, that provides higher quality graphical information, and that enables the user to access the navigation information at desired times of his choosing.

SUMMARY OF THE INVENTION

The present invention is directed to a vehicle navigation system in which both textual and graphical navigation information is downloaded from a web-based source and uploaded into the vehicle navigation system, such as by using a personal electronic device as a transfer medium. The user may then access the navigation information in graphical, textual, and/or audial form at times of his choosing, and may interrupt other active infotainment sources in doing so. The vehicle's GPS system may be utilized to control the timing of the graphical, textual, and/or audial presentations of the navigation information so that the user is provided with the information when it is needed.

The invention comprises, in one embodiment thereof, an automotive vehicle navigation method including obtaining electronic textual navigation information and converting the textual navigation information into audio data. The audio data is stored within the vehicle and is played back within the vehicle in sequential increments that correspond to respective legs of a trip being made by the vehicle.

The invention comprises, in another embodiment thereof, an automotive vehicle navigation method including providing audio navigation data within the vehicle. Second audio data is audibly played within the vehicle. The playing of the second audio data is repeatedly interrupted by audibly playing back the audio navigation data in sequential increments in association with respective legs of a trip being made by the vehicle.

The invention comprises, in yet another embodiment thereof, an automotive vehicle navigation method including storing audio navigation data and/or textual navigation data within the vehicle. Vehicle location data is received in real time and is used to determine the vehicle's progress in a trip being made by the vehicle. The audio navigation data and/or textual navigation data is played back within the vehicle in sequential increments that correspond to the vehicle's progress in the trip.

An advantage of the present invention is that the user may receive navigation directions in text form.

Another advantage is that the user may receive navigation directions in audio form.

Yet another advantage is that higher quality graphical navigation information is provided.

A further advantage is that the navigation system enables the user to access the navigation information on an as-needed basis.

A still further advantage is that the user may interrupt other streams of infotainment content to receive the navigation information in visual or audial form.

BRIEF DESCRIPTION OF THE DRAWINGS

The above-mentioned and other features and advantages of the invention will become more apparent to one with skill in the art upon examination of the following figures and detailed description. The components in the figures are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the invention. Moreover, in the figures, like reference numerals designate corresponding parts throughout the different views.

FIG. **1** is a block diagram of one embodiment of a navigation system of the present invention.

FIG. **2** is a diagram of one embodiment of the data flow of the navigation system of FIG. **1**.

FIG. **3** is a plan view of the head unit of FIG. **1** in audio mode.

FIG. **4** is a flow chart of one embodiment of the operation of the navigation system of FIG. **1**.

FIG. **5** is another flow chart of the operation of the navigation system of FIG. **1**.

FIG. **6** is a plan view of the head unit of FIG. **1** in the icon sub-mode of the direction mode.

FIG. **7** is a plan view of the head unit of FIG. **1** in the map sub-mode of the direction mode.

FIG. **8** is plan view of the head unit of FIG. **1** in the VCDX sub-mode of the audio mode.

FIG. **9** is a flow chart of one embodiment of an automotive vehicle navigation method of the present invention.

FIG. **10** is a flow chart of another embodiment of an automotive vehicle navigation method of the present invention.

FIG. **11** is a flow chart of yet another embodiment of an automotive vehicle navigation method of the present invention.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

Referring to FIG. **1**, there is shown one embodiment of a vehicle navigation system **10** of the present invention for a vehicle **12**. In one embodiment, vehicle **12** is a type of vehicle that travels on roads, such as an automobile or truck, for example. Within vehicle **12** may be navigation system components such as global positioning system (GPS) module **14**, speed sensor **16**, wheel sensor **18**, processor **20**, communications link **22**, and a user interface **24** including port **26**, audio speaker **28**, port **30**, and head unit **32**. In addition to the components within vehicle **12**, navigation system **10** may include satellite **34**, electronic memory device **38**, personal electronic device (PED) **56**, and a personal computer (PC) **40** in communication with a central navigation database **42** through the Internet **44**.

Database **42** may be a commercially accessible, searchable source of navigation information, such as may be provided by MAPQUEST or GOOGLE MAPS, for example. Before a trip is commenced, a user may specify a trip to be made by vehicle **12**, e.g., the trip's beginning and ending coordinates, as a search term of database **42**. As described in more detail below, in response to the search request, navigation information may be retrieved from database **42** and downloaded to vehicle **12**.

Satellite **34**, GPS **14**, speed sensor **16** and wheel sensor **18** may together form a vehicle positioning apparatus that determines location data associated with vehicle **12**. GPS **14**, speed sensor **16**, wheel sensor **18** and satellite **34** may cooperate to continually pinpoint the exact location of vehicle **12** on the surface of earth, expressed in latitude and longitude, as is well known. The change in the vehicle location over time, as determined by GPS **14** and satellite **34**, provides some indication of the direction in which vehicle **12** is heading, i.e., the heading direction. However, GPS **14** and satellite **34** may not be sufficient to accurately ascertain the heading direction of vehicle **12** when vehicle **12** has recently made a turn. Thus, in order to more accurately determine the heading direction, wheel sensor **18** may provide the direction in which the wheels, e.g., front wheels, of vehicle **12** are turned, and speed sensor **16** may provide the speed of vehicle **12** while vehicle **12** is turning in the directions determined by the positions of the wheels. By analyzing the signals from speed sensor **16** in conjunction with the signals from wheel sensor **18**, processor **20** may determine the change in heading direction as compared to the more generalized heading direction provided by satellite **34** and GPS **14**. It is also possible, in another embodiment, for the heading direction of the vehicle to be at least partially determined by use of a compass on-board vehicle **12**.

Processor **20** may include an electronic memory device **46** that stores navigation information, e.g., maps, audio-based directions and text-based directions, which may be downloaded from database **42** via Internet **44** and PC **40**, and which may be uploaded to vehicle **12** via link **22**, memory device **38**, and/or PED **56**. That is, the navigation information may originate in central navigation database **42**, and may be transferred to memory device **46** by any of various routes. In one embodiment, the navigation information is transferred from database **42** to memory device **46** via Internet **44**, PC **40**, antenna **50**, antenna **48** and communications link **22**. PC **40** may be disposed inside a building (not shown) adjacent to which vehicle **12** is parked. The navigation information may then be transmitted from antenna **50** to antenna **48** via air-borne signals, as indicated at **52**.

In another embodiment, the navigation information is transferred from PC **40** to memory device **46** via PC port **54**, memory device **38** and port **26**. Memory device **38** may be in the form of a secure digital memory card, commonly known as an "SD memory card". In other embodiments, memory device **38** may be in the form of an SDIO (secure digital input/output) card, a USB memory or flash drive, a compact flash card, or a memory stick, for example. Memory device **38** may be inserted into port **54** so that PC **40** may write the navigation information onto memory device **38**. Memory device **38** may then be inserted into port **26** such that the contents of device **38** may be read and copied into memory device **46**.

In yet another embodiment, the navigation information is transferred from PC **40** to memory device **46** via PC port **54**, memory device **38**, PED **56** and port **30**. Memory device **38** may be inserted into port **54** so that PC **40** may write the navigation information onto memory device **38**. Memory device **38** may then be inserted into PED **56** such that PED **56** may process the contents of device **38** and may display the contents on a display screen (not shown) of PED **56**. PED **56** may then be inserted into port **30**, or otherwise connected to port **30** such as via a communication wire, such that the contents of memory device **38** may be read and copied into memory device **46**. PED **56** may be in the form of an MP3 player, iPod® or other brand of portable media player, for example. It is possible for PED **56** to include internal memory (not shown) that may perform the function of memory device **38** and thereby enable PED **56** to be directly connected to port **54**. As described above, processor **20** is communicatively coupled to the vehicle positioning apparatus (including satellite **34**, GPS **14**, speed sensor **16** and wheel sensor **18**) and to the source of navigation information (including link **22** and ports **26**, **30**).

PC **40** may include a WINDOWS or server application **58** (FIG. **2**) including a Speech Text Engine **60** and an MP3/AAC (advanced audio coding)/WMA (Windows Media Audio) Encoder **62** which may cooperate to translate textual navigation information **64** from database **42** into audio data **66** that may be played back on speaker **28**. Application **58** may compile or otherwise organize audio data **66** and navigation information taken directly from database **42**, such as textual data **64** and graphical map data **68**, into Tracks **1** through N, as shown in FIG. **2**. In one embodiment, text data **64** and map data **68** are in the form of standard audio format tags, e.g., ID3 tags, which are associated with the respective portion of audio data **66** that is in the same track as the text data and map data.

Each track may correspond to a respective navigation instruction retrieved from database **42**. For example, Track **1** may correspond to the first instruction, "Head north on GA-74 toward Dividend Dr", that is retrieved from database **42**; and Track **2** may correspond to the second instruction, "Turn right at GA-54 E", etc. Thus, tracks may be sequential increments of navigation information that are associated with respective legs of a trip being made by vehicle **12**. Application **58** may compile or otherwise organize the sequential tracks into a Play List **70** that may specify the order in which the tracks may be played back for and by the user. As indicated by arrow **72** in FIG. **2**, the navigation information as organized into tracks and a play list may be transferred to a memory device **38**, or to some equivalent memory device incorporated in PED **56**. As indicated by arrow **74**, the navigation infor-

mation then may be transferred to a memory device **46** in a car radio or other infotainment module having a head unit **32**. It is also possible for the navigation information to be transferred from PC **40** to memory device **46** via antennae **48**, **50** and link **22**.

Head unit **32** is shown in more detail in FIG. **3**, wherein head unit **32** is in its audio mode, and, more particularly, in its iPod sub-mode within its audio mode, as indicated by rectangular sub-mode indicator **75**. Head unit **32** may include a graphical display screen **76** that may be in the form of a quarter video graphics array (QVGA). Display screen **76** may be communicatively coupled to processor **20**, and may display audio information, such as album title, track title and artist name, while in the audio mode, and may display graphical and/or textual navigation information while in the direction mode.

Head unit **32** may include a conventional slot **78** for receiving a CD or DVD, and may also include pushbuttons **80***a-m* which may perform dual functions that depend on whether head unit **32** is in audio mode or direction mode. For example, in the embodiment shown, pushbuttons **80***a-b* may be "UP" and "DOWN" pushbuttons, respectively. Pushbuttons **80***a-b* may be used to switch between the audio mode and the direction mode, may be used to switch between sub-modes within the audio mode and the direction mode, and may be used to switch between options within the sub-modes, as described in more detail hereinbelow with reference to FIG. **4**.

In one embodiment, upon powering ON, as indicated at **82** in FIG. **4**, system **10** enters audio mode **84**, and, more particularly, radio sub-mode **86**. Within audio mode **84**, a user may use UP and DOWN pushbuttons **80***a*, **80***b* to toggle through radio sub-mode **86**, very compact digital exchange (VCDX) sub-mode **88**, DVD/CD sub-mode **90**, Auxiliary/Bluetooth (AUX/BT) sub-mode **92**, and iPod sub-mode **94**. Further, a user may use UP and DOWN pushbuttons **80***a*, **80***b* to toggle through the various options within the sub-modes. In a particular embodiment, a user may use UP pushbutton **80***a* to proceed through the audio sub-modes and options therein in a counterclockwise direction with reference to the layout of FIG. **4**. Conversely, the user may use DOWN pushbutton **80***b* to similarly proceed in a clockwise direction.

Upon entering iPod sub-mode **94**, it is determined at **96** whether an iPod or other PED **56** connected to port **30** has navigation information for display or playback on head unit **32**. If so, system **10** may enter direction mode **98**, and, more particularly, icon sub-mode **100**. In a particular embodiment illustrated in FIG. **5**, a user may select a direction play list, as shown at **102**, from an iPod menu **104** to thereby start the direction play list, as shown at **106**. In icon sub-mode **100** (FIG. **4**), display **76**, as shown in FIG. **6**, may display text and or graphic images representing text data **64** of individual tracks of navigation information retrieved from database **42**. In the specific illustration of FIG. **6**, the displayed text data **64** includes a textual indication of distance, such as "0.2 miles", a textual indication of the track number associated with the image, such as "5", and a textual direction or instruction, such as "Take the Virginia Exit". Text data **64** may also include some graphical image data, such as directional arrow icon **108**. Speaker **28** may audibly playback a voice speaking the non-graphical portions of text data **64**. For example, concurrently with the display of the image illustrated in FIG. **6**, a simulated or computer generated voice may state "Step **5**, after driving zero point two miles, take the Virginia exit".

In one embodiment, the computer generated voice interrupts the normal audible playing of audio mode **84**. When the computer generated voice has completed stating the directions, speaker **28** may automatically return to the normal audible playing of audio mode **84**, even while display screen **76** continues to display navigation information within direction mode **98**. If the user would like to hear the spoken directions again, he may press a repeat pushbutton **80**j to do so.

The user may use TRACK DOWN and TRACK UP pushbuttons **80***c*, **80***d* to switch between tracks of navigation information. Specifically, the user may press TRACK UP pushbutton **80***d*, as indicated at **110** in FIGS. **4** and **5**, to play back the next track in the sequence. That is, with the Track **5** navigation information being displayed as shown in FIG. **6**, pressing TRACK UP pushbutton **80***d* may result in text display of the Track **6** navigation information as well as audio playback of the voice speaking the Track **6** navigation information. Conversely, the user may press TRACK DOWN pushbutton **80***c*, as indicated at **112** in FIGS. **4** and **5**, to play back the previous track in the sequence. That is, with the Track **5** navigation information being displayed as shown in FIG. **6**, pressing TRACK DOWN pushbutton **80***c* may result in text display of the Track **4** navigation information as well as audio playback of the voice speaking the Track **4** navigation information.

At any time within direction mode **98**, the user may press MAP pushbutton **80***k* to toggle back and forth between icon sub-mode **100** and map sub-mode **116**. In map sub-mode **116**, display screen **76** displays graphical map data **68** associated with the currently selected track. For example, if MAP pushbutton **80***k* is pressed with display screen **76** in its state shown in FIG. **6**, display screen **76** switches to the graphical display shown in FIG. **7**, in which map data **68** associated with Track **5** is illustrated. Pressing TRACK DOWN and TRACK UP pushbuttons **80***c*, **80***d* while in the map sub-mode **116** may enable the user to switch between graphical displays of map data **68** associated with the various tracks.

As indicated at **118** in FIG. **4**, pressing DOWN pushbutton **80***b* while in direction mode **98** results in operation of system **10** returning to audio mode **84**, in particular to AUX/BT sub-mode **92**. Within AUX/BT sub-mode **92**, it is determined at **120** whether an auxiliary input is present, in which case operation continues under auxiliary option **122**. If no auxiliary input is present, then operation continues under Bluetooth audio option **124**. Similarly, pressing UP pushbutton **80***a* while in direction mode **98** results in operation of system **10** returning to audio mode **84**, in particular to radio sub-mode **86**.

As indicated at **126** in FIGS. **4** and **5**, the user may use Direct Switch pushbutton **80***m* on the entertainment system center (ESC), i.e., on head unit **32**, to toggle between audio mode **84** and direction mode **98**. When pushbutton **80***m* is actuated, operation may return to the particular sub-mode within audio mode **84** or direction mode **98** from which operation last exited. In addition, or alternatively, to Direct Switch pushbutton **80***m* being provided on head unit **32**, it may also be provided on the steering wheel of vehicle **12**.

In one embodiment, VCDX3 option **128** of VCDX sub-mode **88** includes providing on display screen **76** a real time view in the rearward direction from vehicle **12**, as illustrated in FIG. **8**. As shown, the image displayed on screen **76** may be a mirror image of the actual captured image in order to make the display more intuitive in that objects on the left-hand side of the screen will be to the driver's left in actuality, and objects on the right-hand side of the screen will be to the driver's right in actuality. A camera (not shown) may be provided on the rear of vehicle **12** in order to capture the image. In addition to selecting VCDX3 option **128** manually by operation of UP and DOWN pushbuttons **80***a*, **80***b*, it is also possible for

system **10** to select VCDX3 option **128** automatically whenever vehicle **12** is placed in reverse gear.

In one embodiment, GPS **14** controls the switching of the current track whose navigation information is presented on display screen **76** and audibly played back on speaker **28**. More particularly, the navigation information may include GPS coordinates associated with each track. The vehicle's current GPS coordinates as determined by GPS **14** may be compared with these stored GPS coordinates in order to determine which of the tracks is associated with GPS coordinates that most closely match the vehicle's current GPS coordinates. The navigation information associated with the best matching track may then be automatically displayed on screen **76** and played back on speaker **28**.

In another embodiment, each track may have associated with it GPS coordinates that, once physically passed by vehicle **12** as vehicle **12** travels along the road, cause system **10** to automatically display and playback the navigation information that is associated with the next track in the sequence. The GPS control of the currently displayed track may be in addition, or in alternative, to the manual control of the currently displayed track via TRACK DOWN and TRACK UP pushbuttons **80***c*, **80***d* as described above. If the GPS control is in addition to the manual control, it may be possible for the user to manually override the GPS-based track control by use of TRACK DOWN and TRACK UP pushbuttons **80***c*, **80***d*.

The GPS may be used to make updates to the initial navigation information that is provided textually, graphically, or audibly with each new track. For example, a track as received from database **42** may initially textually and audibly indicate a certain distance to a next turnoff, such as "in 0.8 mile, take exit 17A". As the GPS senses the progression of vehicle **12** towards the turnoff, the textual and/or audible indications of distance may be automatically updated to read and state "in 0.7 mile, take exit 17A", "in 0.6 mile, take exit 17A", etc. Moreover, the graphical map information displayed on screen **76** in association with map data **68** may also be updated based on GPS information. In a particular embodiment, a vehicle icon **130** (FIG. **7**) may be provided within the graphical display at a location that corresponds to the current location of vehicle **12** as determined by GPS **14**. As the location of vehicle **12** changes as it travels along the road, the location of icon **130** within the graphical display may change correspondingly.

In yet another embodiment, GPS **14** may be used to determine the relationship between the current location of vehicle **12** and the vehicle's destination, or between the current location of vehicle **12** and some other point of reference. For example, after calculating the positional relationship, navigation system **10** may textually and/or audibly state, for example, "the destination is one-half mile to the right". Additionally, or alternatively, the navigation system may state the direction in terms of the cardinal directions, such as by stating "the destination is one-half mile to the southwest."

The present invention may also be applied to a head unit that does not include a display that is capable of displaying graphical or textual navigation information. Particularly, the navigation system may provide only audial navigation information, the playback of which may be controlled via GPS and/or manually by the use of pushbuttons. In one embodiment, the navigation information may be played back by any vehicle infotainment system having MP3/AAC/WMA (Windows Media Audio) capability.

FIG. **9** illustrates one embodiment of an automotive vehicle navigation method **900** of the present invention. In a first step **902**, electronic textual navigation information is obtained. In the embodiment illustrated in FIG. **2**, for example, text data **64** is retrieved from database **42** and downloaded to application **58** within PC **40**. In a next step **904**, the textual navigation information is converted into audio data. More particularly, in the embodiment shown in FIG. **2**, speech text engine **60** may translate text data **64** into speech data, and then the speech data may be converted into a desired audio data format, such as MP3/AAC/WMA. Next, in step **906**, the audio data is stored within the vehicle. As described above with reference to FIG. **1**, the audio data may be stored in memory device **46** of vehicle **12** via antennae **48**, **50** and link **22**, via port **54**, memory device **38** and port **26**, or via port **54**, memory device **38**, PED **56** and port **30**. In a final step **908**, the audio data is played back within the vehicle in sequential increments that correspond to respective legs of a trip being made by the vehicle. For instance, in the embodiment illustrated in FIG. **2**, the audio data is played back within vehicle **12** in sequentially ordered tracks, each of which may correspond to a respective portion of a trip that vehicle **12** is making.

FIG. **10** illustrates another embodiment of an automotive vehicle navigation method **1000** of the present invention. In a first step **1002**, audio navigation data is provided within the vehicle. More particularly, as shown in FIG. **2**, audio navigation data **66** is provided within vehicle **12**. Next, in step **1004**, second audio data is audibly played within the vehicle. For example, as shown in FIG. **4**, radio sub-mode **86** of audio mode **84** is entered upon power ON **82**, thereby causing audio data from the radio to be audibly played on speaker **28** within vehicle **12**. In a final step **1006**, the playing of the second audio data is repeatedly interrupted by audibly playing back the audio navigation data in sequential increments in association with respective legs of a trip being made by the vehicle. For example, by pressing Direct Switch pushbutton **80***m* on head unit **32**, the user may enter direction mode **98** in which audio data **66** of the current track is played back to thereby interrupt the playing of the radio. The current track represents an increment of navigation data that is associated with a respective portion of the trip being made by vehicle **12**. Upon completion of the playing back of the audio data of the current track, the system may return to playing the radio, even though display screen **76** may continue to display navigation information. When the user has reached the next leg of the trip and hence would like to receive the next track of navigation information, he may press TRACK UP pushbutton **80***d* to thereby commence visual and audio playback of the next track. As a result, the playing of the radio is again interrupted by audibly playing back the audio data associated with the new track. The process of repeatedly interrupting the radio, or some other audio source within audio mode **84**, continues until the navigation information associated with the final leg of the trip has been played back. In another embodiment in which the timing of the playback of the next track is controlled according to the vehicle location as determined by GPS **14**, the interruption of the radio or some other "second audio data" may occur automatically. That is, the playing of the second audio data may be interrupted via electronic control rather than requiring the user to press any button such as Direct Switch pushbutton **80***m* or TRACK UP pushbutton **80***d*.

FIG. **11** illustrates yet another embodiment of an automotive vehicle navigation method **1100** of the present invention. In a first step **1102**, audio navigation data and/or textual navigation data is stored within vehicle **12**. In the embodiment illustrated in FIG. **2**, for example, audio data **66** and text data **64** are stored in memory device **46** within vehicle **12**. In step **1103***a*, direction data is received from a wheel sensor, the direction data specifying a direction in which wheels of the vehicle are turned. In step **1103***b*, speed data is received from

a speed sensor, the speed data specifying a speed of the vehicle while the wheels of the vehicle are turned in the specified direction. In step **1103***c*, the direction data and the speed data are analyzed to thereby determine a change in heading direction of the vehicle. In a next step **1104**, vehicle location data is received in real time. As a particular example, GPS **14** provides processor **20** with vehicle location data in real time. Next, in step **1106**, the vehicle location data is used to determine the vehicle's progress in a trip being made by the vehicle. GPS coordinates associated with each track may be provided in the navigation information. The vehicle's actual current GPS coordinates as determined by GPS **14** may be compared with these stored GPS coordinates in order to determine which of the tracks the vehicle's current location corresponds to. Thus, the vehicle's progress along the trip the vehicle is taking may be determined. In a final step **1108**, the audio navigation data and/or the textual navigation data is played back within the vehicle in sequential increments that correspond to the vehicle's progress in the trip. For instance, in the embodiment illustrated in FIG. **2**, audio data **66** and text data **64** are played back within vehicle **12** in sequentially ordered tracks, each of which may correspond to a respective portion of a trip that vehicle **12** is making.

The graphical and textual indications have been described herein as being provided on a head unit. However, in another embodiment they are provided on a windshield via a heads-up display.

While the present invention has been described with reference to specific exemplary embodiments, it will be evident that various modifications and changes may be made to these embodiments without departing from the broader spirit and scope of the invention as set forth in the claims. Accordingly, the specification and drawings are to be regarded in an illustrative rather than a restrictive sense.

What is claimed is:

1. An automotive vehicle navigation method, said method comprising the steps of:

obtaining electronic textual navigation information;

converting the textual navigation information into audio data;

storing the audio data within the vehicle;

playing back the audio data within the vehicle in sequential increments that correspond to respective legs of a trip being made by the vehicle;

storing the electronic textual navigation information within the vehicle;

playing back the electronic textual navigation information within the vehicle in sequential increments that correspond to the respective legs of the trip being made by the vehicle, wherein the audio data and the electronic textual navigation information are stored and played back together in a sequential tracks corresponding to the respective legs of the trip;

obtaining electronic graphical navigation information;

storing the electronic graphical navigation information within the vehicle;

playing back the electronic graphical navigation information within the vehicle in sequential increments that correspond to the respective legs of the trip being made by the vehicle; and

selectively switching between the playing back of the electronic textual navigation information and the playing back of the electronic graphical navigation information.

2. An automotive vehicle navigation method, said method comprising the steps of:

storing within the vehicle at least one of audio navigation data and textual navigation data;

receiving direction from a wheel sensor, the direction data specifying a directing in which wheels of the vehicle are turned;

receiving speed data from a speed sensor, the speed data specifying a speed of the vehicle while the wheels of the vehicle are turned in the specified direction;

analyzing the direction data and the speed data to thereby determine a change in heading direction of the vehicle;

receiving vehicle location data in real time from a GPS;

using the vehicle location data to determine the vehicle's progress in a trip being made by the vehicle;

playing back the at least one of the audio navigation data and textual navigation data on a head unit within the vehicle in sequential increments that correspond to the vehicle's progress in the trip;

calculating a positional relationship between a current location of the vehicle and a destination of the vehicle; and

using a navigation system to textually and/or audibly stat a distance and relative direction of the destination relative to the changed heading direction of the vehicle, the relative direction being stated in terms of cardinal directions.

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